Electrolytic cell and method of assembling and operation of an electrolytic cell

TECHNICAL FIELD

The invention relates to an electrolytic cell in accordance with the preamble of the first claim.
It likewise relates to a method of assembling an electrolytic cell and a method for operation of an electrolytic cell in accordance with the preamble of the independent method claims.

BACKGROUND OF THE INVENTION

The production of a halogen biocide, preferably sodium hypochlorite, by electrolysis of salt water like sea water is well known in the art.
US 4,100,052 discloses an electrolytic cell for the generation of low cost halogen biocidally active agent from an aqueous solution having a low halogen salt content for use in the treatment of sewage or other liquid affluents, especially those of fresh water swimming pools or fresh water cooling towers. The electrolytic cell is used in line with pumps generally associated with the distribution of waters for swimming pools or cooling towers.
Such an electrolytic cell for the production of halogen for use as biocidal agent consists of: an enclosure; means for connecting the enclosure to a liquid distribu-

tion system of the facility to be biocidally affected so that the liquid must flow there through; a plurality of spaced planar electrode plates attached to the enclosure interior in parallel fashion; each of the spaced planar electrode plates having coatings on one side thereof such that ionic potential travel is promoted in one direction; means for connecting a power source to substantially less than all of said spaced planar electrode plates to promote an electrical field across the spaced planar electrode plates to evolve halogen which is dissolved in the liquid flowing through the distribution system; and a halogen salt concentration in the liquid greater than 0.5 grams per liter.

US 4,790,923 discloses a further improved electrolytic cell for producing a halogen biocide and oxygen in a liquid containing a halogen salt as the liquid is passed there through. The electrolytic cell contains a plurality of electrode plates which are mounted in spaced apart parallel relationship in the cell with less than all of the electrode plates being connectable to a suitable power supply. The cell is configured so that the end edges of at least the electrode plates which are connectable to the power supply are encased in an electrically insulative chemically resistant material to prevent current leakage between those plates.

Such electrolytic cell are quite complex, large in size and need special treatment and appliance to operate the cells.

SUMMARY OF THE INVENTION

Accordingly, one object of the invention is to provide a easy to manufacture and easy to use and operate electrolytic cell.

According to the invention, this is achieved by the features of the first claim.

The advantages of the invention can be seen, inter alia, in the fact that only few components are used to build up the cell. This allows easy manufacturing of the cell, also in developing countries.

Further advantageous embodiments of the invention emerge from the subclaims.

The cell consists in general only of two types of components, the cell enclosure consisting of two identical parts and the electrodes. This is opposed to other classical cell devices, which require additional spare parts to hold the cell and electrodes together.
The small dimensions of the cell enable a consumption lower than 60 watts, which is compatible and adaptable to power supply available in developing countries. As DC power supply 12 V car batteries, transformer, solar panel etc. can be used. As the weight of the cell is less than 1 kg, preferably less than 200 g. Such a cell is easily portable, especially also regarding its small size of less than 1 cubic dm for a weight of less than 200 g.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Fig. 1 shows a cross section through an inventive electrolytic cell;

Fig. 2 shows a longitudinal cross section through the electrolytic cell;
Fig. 3 shows a further longitudinal cross section through the electrolytic cell;
Fig. 4 shows a side view of the electrolytic cell at assembly.

Only those elements that are essential for an understanding of the invention are shown.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, in figure 1 and 2 an electrolytic cell 1 comprising two outward polar planar electrode plate 2 and 3, at least one inward bipolar planar electrode plate 4 and an enclosure 5. The electrode plates 2, 3 and 4 are arranged in slits 6 of the enclosure 5. The slits 6 are designed to hold the electrode plates and are equally spaced apart from each other so that the electrode plates are also equally spaced apart from each other. The two outward polar planar electrode plate 2 and 3 are each connected to a conductor in the form of a rod or wire 7 and 8. At least at the area of the conductors 7, 8 the enclosure is formed to build a recess 12 to enclose the conductors 7, 8. The inward secondary electrode plates 4 are further protected by a protective cover 13 which covers the end parts of the plates 4.

Electric connection is made from a suitable direct current (DC) power source, not shown, to the wires 7 and 8 and to each of the oppositely located polar electrode plates 2 and 3. These electrode plates which are connected to the power source are referred to as the primary electrode plates, and the other plates 4 which are located between the primary electrode plates 2 and 3 are not connected to the power source and are commonly referred to in the art as bipolar electrode plates.

The polar electrode plates 2 and 3 of the electrolytic cell 1 function as anode and cathode. For the proper function of the electrolytic cell 1 of the present invention, the electrolytic cell contains at least one of the hereinbefore described bipolar electrode plates 4. A bipolar electrode plate is defined as having one surface which acts as a cathode with the opposite surface acting as an anode. In the electrolytic cell 1, the polarity of the primary electrode plates 2 and 3 can be periodically reversed, such as by means of a switching device in the power supply or by simply changing the connection of the DC power source. This is especially helpful for cleaning the carbonate scale off of the cathode surfaces which inherently forms thereon as a result of the electrolysis process.

When the DC power supply is operating, the primary electrode plate 2 is acting as an anode and the other primary electrode 3 is acting as cathode.
The anode 2 facing surfaces of each of the secondary electrode plates 4 will be acting as cathode as a result of ionic charging. The cathode 3 facing surfaces of each of the secondary electrode plates 4 will be acting as anodes due to ionic charging. Thus, each adjacent pair of electrode plates forms an individual electrolytic cell, with the cell 1 being made up of a plurality of such individual cells. In the shown example, the electrolytic cell 1 has a total of three individual cells, with it being understood that that number may be varied. When the polarity of the cell 1 is reversed, the primary electrode plate 2 will be acting as cathode and the primary electrode plate 3 will be acting as anode. The secondary bipolar electrode plates 4 will change from anode to cathode and from cathode to anode accordingly. Therefore, as a result of the polarity of the primary electrode plates 2 and 3 being reversible, the polarity of each individual cell is also reversible.

According to Figure 2 and 3 the enclosure 5 is made of two parts 5A and 5B which are connected by a connector 9 which comprises a plug 10 and a receptacle 11.

The enclosure is preferably made of high density polyethylene, but can be made of any other electrically insulating chemically resistant material, preferably plastic. The two parts 5A and 5B are preferably the same, identical parts, see also figure 4. Through the special designed plug and receptacle no particular assembling tools such as screws or metallic parts are required.

For use with 12 volts and 3 ampere the electrode plate will have preferably the size of 110 mm to 50 mm with a thickness of 1 mm. The electrodes are made of titanium coated with a mixed precious metal oxide. Such electrodes may be purchased from De Nora Elettrodi S.p.A. under the brand name DSA®, dimensionally stable anodes. The titanium breakdown potential is approximately 7 volts.
The electrode plates will be spaced apart 5 to 15 mm, preferably 11 mm, from each other in the enclosure.
The total weight of a cell as described above will be less than 200 grams and therefore can be easily carried around. The size of such a cell is less than one cubic dm.
These dimensions enable a consumption lower than 60 watts which is compatible and adaptable to power supply in developing countries.

In figure 4 the cell is shown during assembly. Part 5A and 5B are identical and made from polyethylene. The electrode plates 2, 3 and 4 are all the same but to the plates 2 and 3 conductors 7 and 8 are attached by welding, brazing or other methods to guaranty electric conduction from the conductors 7, 8 to the primary plates 2 , 3. Afterwards the plates 2 and 3 are inserted into the part 5B into the preformed slits 6. Inward the secondary plates 4 are inserted into the parallel slits 6. Then the identical part 5A is turned 180 degrees in respect to the part 5B and the conductors 7, 8 are introduced into the recesses 12. Now the part 5A is pushed down over the electrode plates which are introduced into the slits 6 of the part 5A. Then the part 5A is connected to the part 5B by each others plug 10 and

receptacle 11. Once assembled, the edges and connectors are protected against voltage above the titanium breakdown potential, approximately 7 volts, by the parts 5A, 5B and the protective cover 13.

Therefore the extreme simplicity of the cell is characterized by:
- Only two types of components, the cell enclosure parts 5A, 5B and the electrode plates as opposed to other classical devices which require additional spare parts to hold the cell and electrodes together.
- Small dimensions to enable consumption lower than 60 watts which is compatible and adaptable to power supply in developing countries like 12 V car battery, transformer, solar panel, etc.
- Weight of less than 200g, preferably less than 160g.
- Size of less than 1 cubic dm.

To use the electrolytic cell a plastic bucket is filled with water and salt and the cell 1 is immersed into the brine solution. The brine solution can also be salty water or sea water. A DC power supply is connected to the wires of the cell. The power supply can be a standard car battery, a direct current generator like a battery charger, a solar generator, a wind mill with a generator, a transformator or the like. Current will flow through the cell with the electrodes and the brine solution as described above and the electrolyses of the solution of sodium chloride will begin. Through the formation of bubbles during the electrolyses and the open design of the cell, free circulation of the liquid inside the cell is allowed and maintained by the continuous production of bubbles.
After a few hours the solution will contain between 3 to 8 grams of sodium hypochlorite.

Example:

A bucket is filled with one liter of water. 25 grams of salt, approximately a soup spoon, is added and diluted in the water. The cell is completely immersed in the solution and supplied by a car battery with 12 volts and 3 ampere continuous current during one hour. During the electrolysis small bubbles are formed which escape from the surface, which indicates normal reaction. The solution must be able to circulate freely inside the cell.
After the reaction the cell is removed from the bucket. The solution obtained contains about 6 grams per liter of pure sodium hypochlorite. For everyday usage as water purification this solution is diluted three times. After dilution the newly chlorinated water should stand for 20 to 30 minutes before drinking.
The electric consumption surrounds about 40 Watts.

For a solution of 2 liters and 50 grams of salt, the reaction is carried out for two hours to receive also a solution that contains about 6 grams per liter of pure sodium hypochlorite. For three liters and 75 grams of salt it is three hours and so on.
A car battery in good condition normally charged can function during about 10 hours without being reloaded, therefore producing 10 liters of solution.
As the polarity of the cell has no importance for the reaction, it can preferably be reversed when starting another reaction.

The invention is of course not restricted to the exemplary embodiment shown and described.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

LIST OF DESIGNATIONS

1	electrolytic cell
2	polar planar electrode plate
3	polar planar electrode plate
4	bipolar planar electrode plate
5	enclosure
5A	first part enclosure
5B	second part enclosure
6	slit
7	conductor attached to 2
8	conductor attached to 3
9	connector
10	plug
11	receptacle
12	recess
13	protective cover